PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Bypass Valves for Steam Plants

We, SULZER FRERES, SOCIETE ANONYME, a Company organised under the laws of Switzerland, of Winterthur, Switzerland, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to bypass valves for steam plants. The purpose of such valves is to operate during abnormal conditions of plant operation, as at starting or on overloads, to protect the turbine or other parts of the plant by allowing the working medium to bypass the turbine or those parts of the plant for which protection is required; the bypassed working medium is conveyed to a starting tank or condenser. The bypass valve is heavily stressed when open, and especially when a mixture of steam and water flows through the valve there may be considerable damage caused by erosion at the exit side of the valve. The reason for such damage is that after the mixture has passed through the narrowest cross-section of the valve, a jet of liquid is formed which impinges at random against the valve housing wall, bounces off and reimpinges upon it. Damage by erosion is caused at the places where the jet impinges, the damage being produced by cavitation. The formation of such jets in the valve may also lead to the valve, and more particularly the closure member thereof, experiencing vibrations which may increase until valve flutter occurs, with resultant damage to the valve. A factor which increases the damage is that the bypass valve experiences considerable temperature variations when it opens to relieve an overload of the steam generator after previously being substantially at ambient temperature, for hot steam then flows through the valve.

The invention aims at providing a valve which does not have these disadvantages.

[5d.]

According to the invention, a bypass valve for a steam plant comprises a closure member which is not rotatable by the medium flowing through the valve and which is movable by a valve spindle between a fully closed position in which the closure member seats on a seating and an open position, and in this valve a plurality of whirl-producing surfaces are so arranged and disposed near the seating that the medium flowing through the valve is given thereby a whirling motion which persists downstream of the said surfaces and through an outlet which is disposed downstream of the said surfaces for all open positions of the closure member. The liquid flowing through the valve is therefore given a whirl so considerable that, downstream of the valve seat, the liquid follows the valve wall and pipe wall in a fairly thick layer and therefor does not form a jet.

Jet formation in a conventional bypass valve, and a number of embodiments of the invention by way of example, will now be described with reference to the accompanying drawings, wherein:

Figure 1 is a longitudinal section through a conventional bypass valve;

Figure 2 illustrates a part of a similar valve but modified in accordance with the invention;

Figure 3 is a cross-section through the valve shown in Figure 2;

Figure 4 illustrates another example of a valve embodying the invention, in longitudinal section;

Figure 5 is a cross-section through the valve shown in Figure 4 taken on the section plane indicated;

Figure 6 illustrates the same valve as is shown in Figure 4 but with the valve member in a different position; and

Figure 7 is a cross-section taken through the valve shown in Figure 6 taken on the section plane indicated.

In the known bypass valve shown in Figure 1, a valve spindle 2 is mounted for axial displacement in a housing 1, in a manner which is known but not shown. The lower end of the valve spindle 2 in Figure 1 has a conical surface 3 which co-operates with a matching conical valve seat surface 4 in the housing 1 and prevents flow through the valve when the spindle 2 is in the closed position. The medium enters through a port 5 connected to a steam generator pipe (not shown) in the direction indicated by an arrow 6.

In order that the flow cross-section of the valve may be adjusted, the valve spindle 2 carries below the surface 3 a prolongation 7 which tapers towards the bottom and which, in dependence upon the position of the valve spindle 2, leaves between itself and the internal diameter of the seat surface 4 a variable annular gap through which the medium can flow to a valve exit port 8. When the valve spindle 2 is raised, the medium enters the valve through the port 5 and, after flowing through the annular gap, forms a liquid jet 9 which impinges against the valve wall or the following pipe wall at a place which is not shown. In the long run this leads to the cavitation erosion previously referred to.

To prevent damage of this kind, in the embodiment of the invention shown in Figures 2 and 3 the prolongation 7 is formed, near the narrowest cross-section of the valve, with grooves 10 generated, for instance, by cutting. The grooves 10 extend over the generated surface of the prolongation 7 at an inclination to the lengthwise axis of the valve spindle 2 and form whirl-producing surfaces. The medium which enters the valve in the direction indicated by the arrow 6 is rotated by the grooves 10 as it flows through the narrowest cross-section of the valve and is applied as a relatively thick layer 12 to the wall of the exit port 8. The formation of jets is therefore obviated, with a consequent reduction in damage caused by erosion and vibration This embodiment of the invention has the special advantage that the bypass valves of existing plants can be provided subsequently with the whirl-producing surfaces.

In the embodiment of the invention shown in Figures 4 to 7, the prolongation 7^1 of the valve spindle 2^1 is cylindrical and the seat surface 3^1 takes the form of a flat shoulder on the valve spindle. Correspondingly, the mating valve seat surface 4^1 in the valve casing is also flat. The seat surface 4^1 merges into a cylindrical transitional zone 11 which has a diameter substantially equal to the external diameter of the cylindrical prolongation 7^1 and which forms a guide therefore. The whirl-producing grooves 10^1 extend helically and their depth increases towards the end face of the prolongation (compare Figures 5 and 7). The flow cross-section of the valve can therefore be adjusted by adjustment of the valve spindle 2^1, and the liquid medium is given a whirling motion as it flows through the grooves. Whereas in Figure 4 the valve spindle 2^1 is disengaged only slightly from the seat 4^1, in Figure 6 the valve spindle 2^1 is in a more fully opened position. If, for instance, the valve is open because of overload and only steam flows through it, the valve spindle 2^1 can be raised so far that the prolongation 7^1 opens the passage 11 completely. Even in this position the working medium flows over the full length of the grooves and is given a persistant whirling motion thereby.

Instead of using the flat valve seat shown in Figures 4—7, a conical seat similar to that shown in Figures 2 and 3 could be used in a different embodiment otherwise similar to that shown in Figures 4—7.

In valves which are devoid of prolongation or in which the prolongation is too short to be formed with whirl-producing surfaces, such surfaces could be provided in the form of appropriately arranged or curved ribs on the valve housing wall or on a section of a replaceable valve seat ring, such section being prolonged in the direction of flow.

Advantageously, in the case of valves where the valve spindle is disposed on the exit side, the whirl-producing surfaces are provided on the valve spindle immediately below the seating surface of the closure member. In valves wherein the valve member performs a rotating movement as the valve is being opened, it may be convenient to provide, downstream of the valve seat, whirl-producing surfaces on the valve member and on the casing inner wall, such surfaces engaging one in another at least in the closed state. In no case is the closure member rotatable by the working medium.

WHAT WE CLAIM IS:—

1. A bypass valve for a steam plant, comprising a closure member which is not rotatable by the medium flowing through the valve and which is movable by a valve spindle between a fully closed position in which the closure member seats on a seating and an open position, and in which a plurality of whirl-producing surfaces are so arranged and disposed near the seating that the medium flowing through the valve is given thereby a whirling motion which persists downstream of the said surfaces and through an outlet which is disposed downstream of the said surfaces for all open positions of the closure member.

2. A valve as claimed in Claim 1 in which the whirl-producing surfaces are disposed in a prolongation of the valve closure member downstream of the valve seat.

3. A valve as claimed in Claim 2 in which the prolongation having the whirl-producing surfaces has a cylindrical generated surface the external diameter of which is substantially

equal to the internal diameter of the valve seat.

4. A valve as claimed in Claim 3 in which the whirl-producing surfaces are in the form of helical grooves in the cylindrical prolongation.

5. A valve as claimed in Claim 1 in which the whirl-producing surfaces are formed in the wall of the valve housing downstream of the valve seat.

6. A valve as claimed in Claim 1 having a replaceable valve seat ring and in which the whirl-producing surfaces are formed in a portion of the valve seat ring which extends in the direction of flow.

7. A valve as claimed in any of the preceding claims in which the flow cross-section of the spaces defined by the whirl-producing surfaces increases as the lift increases.

8. A valve as claimed in Claim 7 in which the said spaces are constituted by grooves of uniform length but of increasing depth.

9. A bypass valve for a steam plant substantially as described with reference to Figures 2 and 3 or Figures 4 to 7 of the accompanying drawings.

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Agents for the Applicants.

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1 SHEET This drawing is a reproduction of the Original on a reduced scale

Fig. 1

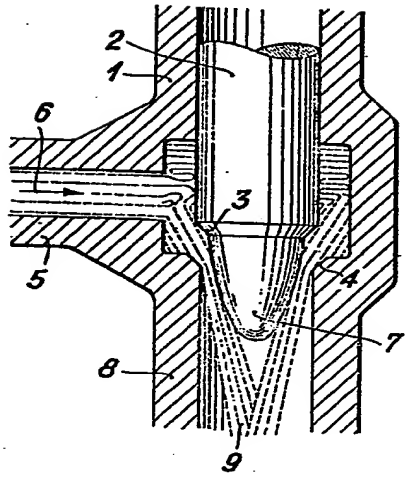

Fig. 2

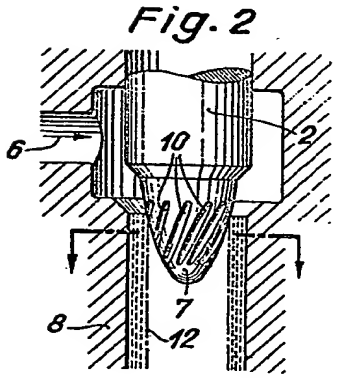

Fig. 3

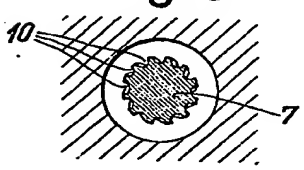

Fig. 4

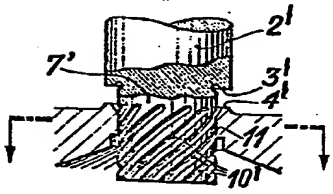

Fig. 6

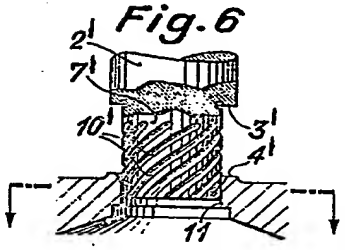

Fig. 5

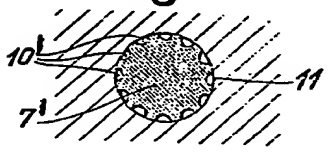

Fig. 7